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FRONT PAGE NEWS

What's Next for Hi-Rel CGA Die Attach?

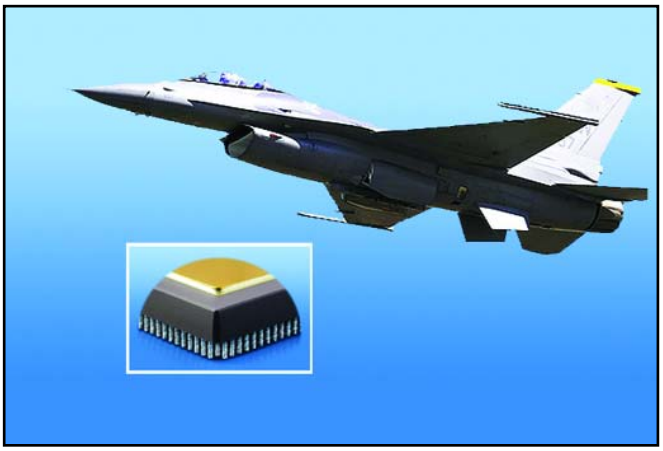
The United States defense industry is hiding a surprising vulnerability. The entire industry relies on a single subcontractor to provide one specific, critical service — attaching solder columns to defense-grade FPGAs and ASICs.

Fewer than 100,000 FPGA and ASIC devices with solder columns, known as column grid arrays (CGAs) are produced each year. These columns are an integral part of the device. Without them, production of ruggedized FPGA devices with columns would come to a sudden halt.

Recipe for Disaster

Stopping CGA production would essentially cripple the defense industry. Like Achilles' heel, the entire defense industry could be brought to its knees by a tiny subcontractor, without a shot being fired. Such a stoppage of delivery of CGA-type FPGA circuits would wreak havoc in the US defense industry, along with the multitude of companies that support it.

This could result in a massive liability to the US military establishment, as well as to its allies.



A single subcontractor is responsible for attaching nearly all solder columns to U.S. defense-grade FPGAs and ASICs.

Surprisingly, the US Department of Defense is aware of this issue, yet no corrective action has been initiated to mitigate this clear and present risk to national security.

Nearly all defense-grade FPGA and ASIC makers fail to qualify a second column attachment vendor. This situation could trigger a catastrophic chain reaction, not only for National Security, but for the multitude of workers who would sit idle should defense-grade FPGA and ASIC devices fail to be delivered.

Companies in the supply chain that use defense grade FPGAs and ASICs are typically divisions or subsidiaries of publicly-held companies who are obligated to comply with the disclosure regulations of the US Securities and Exchange Commission (SEC). The SEC requires public companies to make written or verbal cautionary statements, commonly known as "Forward-Looking Statements and Risk Factors."

Forward-looking statements are based on management's views at the time to disclose what may relate to future assumptions, developments, results, conditions or other events that may impact revenues, earnings, market conditions, new strategies, and the competitive environment.

Public companies are required to disclose risk factors associated with competitive pressures, con-

sumer demand, regulatory and litigation developments, and to warn stakeholders of possible events, such as changes in pricing or delivery that could adversely affect the company materially.

None of the top 10 makers of FPGA devices bother to disclose potential supply chain risks specifically associated with a failure to receive timely-deliveries of FPGA and ASIC devices with columns. It is a secret that is hiding in plain sight.

Single-Source Risk

The controlling owner of this sole subcontractor (a privately held company) is nearing an age when most business owners are planning for retirement. It is perhaps overly optimistic to assume that this tiny subcontractor will be in business five years, ten years or even twenty years from now.

None of the top 10 makers of FPGA devices bother to disclose the potential supply chain risks of a failure to receive timely deliveries of FPGA and ASIC devices with columns.

However, the defense industry has ongoing programs that will require delivery of devices with columns even 30 years from now.

Companies with owners whose retirement is on the horizon typically begin to wind down their businesses and slow down the deployment of fresh capital into operations that could be used to invest in new equipment and human resources.

Most importantly, the current sole-source subcontractor referenced above might not be able to accommodate a surge in demand for ruggedized FPGA and ASIC components during a national emergency.

Simply stated, if this sole column attachment subcontractor should face a production shutdown, then deliveries of defense-grade FPGA and ASIC devices with columns will come to a halt. The defense establishment would be incapable of providing black box systems to downstream customers due to a lack of these devices.

Meanwhile, the Defense Logistics Agency (DLA), an arm of the Department of Defense, has not certified an alternative subcontractor for column attachment.

A stoppage of production caused by the demise of a sole-source vendor could trigger a catastrophic chain reaction in the US defense establishment and ultimately adversely affect our allies, who rely on a continuous supply of these products from the United States. Economically, the stoppage of supply of column interconnects could cascade in the widespread loss of jobs for American workers throughout the supply chain.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U.S. Tech,
Jan/Feb 2022 issue.

There is No Plan B

The defense establishment needs to be more involved and to encourage the industrial base to expand their reliance beyond the single source subcontractor who provides 90 percent of America's solder column attachment services. A strategic safety net is needed to protect the defense industry in the event of the loss of such a critical supplier.

America must shore up its self-reliance on defense grade FPGA components, because the country cannot afford to lose superiority in these critical devices. Hopefully, proactive thought leaders in the supply chain are listening.

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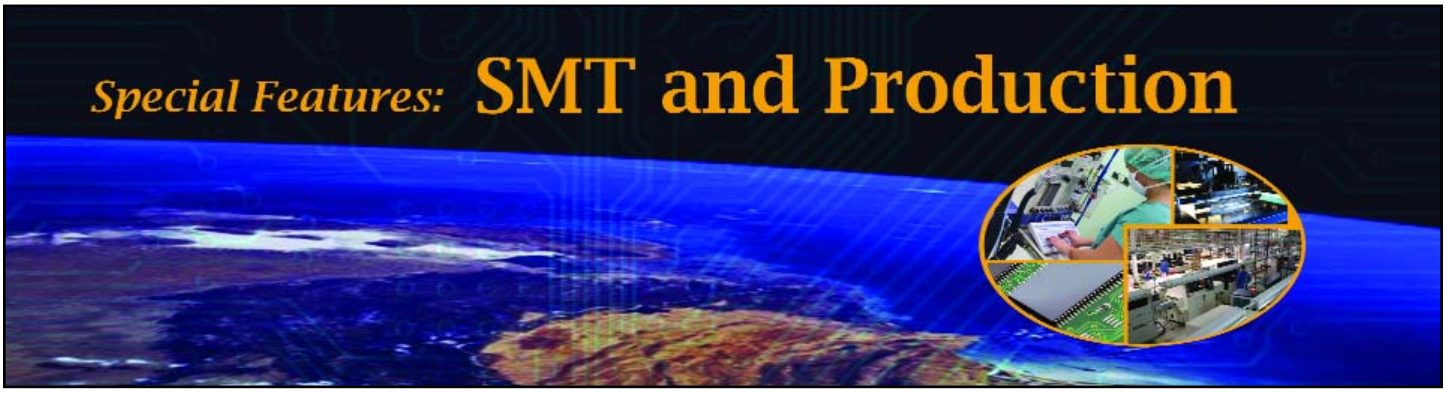

National Security at Risk: Dangers of a Sole Source Monopoly

By Martin Hart, CEO, TopLine Corporation

In today's troubled world, we rely on our defense establishment and industrial base to keep us secure with adequate weapons and sophisticated systems to defend our homeland. We take it for granted that, when we wake up in the morning, our national security is credible and that the infrastructure to support it is reliable and secure.

But the guidance systems for missiles and warfighters, for example, rely on electronic components. Surges in demand and disruptions in the supply chain, whether natural or man-made, are a risk at any given time. Shortages of semiconductor chips have slowed production and consequently the supply of automobiles available for consumers to purchase. The same principle — shortages of parts — can obviously affect the availability of missiles and warfighters in times of conflict, with far more critical potential impact.

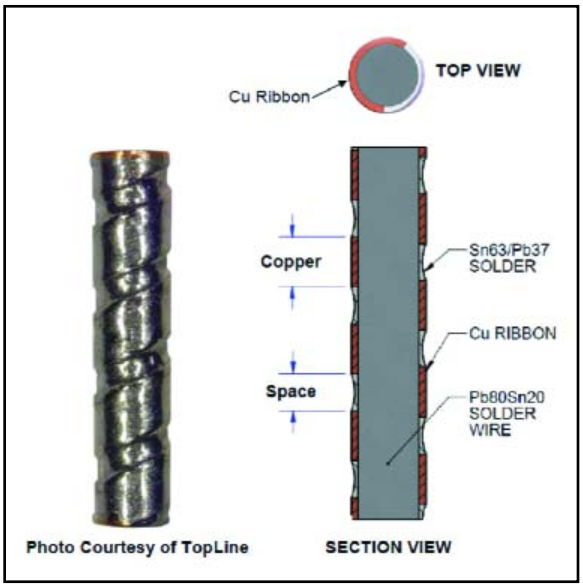

Diagram of a solder column, used to connect FPGA devices to PCBs.

Military leaders in our command structure are keenly aware that risks and vulnerabilities constantly challenge the industrial base's ability to seamlessly perform as expected. Indeed, experts in the Defense and Aerospace industrial base routinely assess risks that include diminishing manufacturing capabilities, especially when relying on sole source suppliers.

And yet it should be noted that most of these big companies listed on the qualified products list by the U.S. Department of Defense rely on smaller subcontractors to supply the materials and subcomponents that come together to create a final product.

Critical Attachments

Let's consider the case of field programmable gate array devices, or FPGAs. They are essential electronic components in sophisticated military and aerospace guidance systems. Warfighters can't fly without

FPGA devices. One would think that America's defense system would make certain that there are multiple, redundant sources for such important devices, and yet this is not so. A sole-source subcontractor effectively constrains America's defense grade FPGA production. How can this be so?

FPGA devices are constructed using hundreds and in some cases thousands of solder columns, a critical subcomponent smaller than a grain of rice, to attach the FPGA to the circuit board or circuit assembly. These columns, which are specially made pins, must be attached to the body of the FPGA before they can be connected to the PCB.

While there are around 10 companies manufacturing radiation-hardened FPGAs in the United States, only one small company is qualified to attach these pins to the component body. Is such a monopoly dangerous? What if a catastrophe such as a fire or other unforeseen disaster should disrupt production at the plant? Without solder columns, an FPGA cannot be effectively used. No FPGA, no warfighter in the air. It's really that simple.

Manufacturers of defense-grade FPGAs are well-established companies. Likewise, makers of ASICs are also major companies. In fact, approximately ten domestic companies make defense- and space-grade FPGA and ASIC devices with solder columns. These manufacturers are well known companies including Xilinx, Microchip, Honeywell, Texas Instruments, and others.

Monopoly suppliers, though rare in the semiconductor industry, can drive up costs if left unchecked. Today, 90% of semiconductor companies that make defense-grade FPGA devices are at the mercy of just a tiny, privately-held subcontractor located in Silicon Valley, California. Its owners may be nearing the age when most business owners are contemplating selling the business or retiring.

Something should be done about this to protect the integrity of the supply chain. Perhaps; but the Defense Logistics Agency (DLA) is responsible for delays in the certification of FPGA column attach subcontractors. Not just anyone can perform column attachment; it is a complex process.

Without solder columns, an FPGA cannot be effectively used. No FPGA, no warfighter in the air.

Time is Running Out

America is racing the clock to certify alternative subcontractors to attach solder columns to defense grade FPGA devices. As a consequence, the U.S. aerospace and defense industry cannot be assured of a continuing supply of ruggedized FPGA components to keep warfighters flying and rockets launching five years from now. A sudden shortage of mission critical FPGA devices is not in the defense industry's best interests.

Semiconductor device makers have not taken action to qualify additional subcontractors to perform column attachment services, a critical process in defense grade FPGA fabrication. The U.S. Department of Defense (DOD) provides guidelines that help identify and mitigate dependency on services provided by single-source subcontractors.

Document SD-22 titled, "Diminishing Manufacturing Sources and Material Shortages (DMSMS), a Guidebook of Best Practices for Implementing a Robust DMSMS Management Program" provides resources to aid FPGA makers who may be striving to broaden their supplier base for components that are critical to the welfare of National Security. Semiconductor device makers, including Microchip and Xilinx, have not taken action to qualify additional subcontractors to perform column attachment services, which are critical to National Security.

What Follows

A disruption in the supply of solder columns can seriously impact the defense and aerospace industries. Responsibility for providing timely delivery of FPGA devices for use in defense applications is entrusted to a small number of civilians in the industrial base. Simply stated, the defense establishment is making a high-stakes gamble that a single subcontractor will be in business five, let alone 30 years from now.

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Mission-Critical FPGAs: U.S. National Defense "Painted into a Corner"

By Martin Hart, CEO, TopLine Corporation

When a specific type of electronic component becomes essential to our National Defense, it is only sensible to ensure a renewable and inexhaustible supply, since by its very nature, such a product bears the status of strategic importance.

This is especially true of mission-critical field programmable gate array (FPGA) devices. An FPGA is an integrated circuit configurable by customers in the field, making such devices desirable for space and defense applications. A fortified version, known as a radiation hardened (RadHard) FPGA, can withstand attacks from electromagnetic and particle radiation in outer space.

FPGAs require solder columns, rather than solder balls, as a critical subcomponent in their final assembly. And yet makers of ruggedized FPGA devices depend upon a single subcontractor to provide services to attach copper wrapped solder columns to FPGA. Should that sole subcontractor somehow go out of business or fail to meet a demand surge, that sudden shortage could result in warfighters not flying and rockets not launching.

Only one subcontractor in the U.S. is qualified to perform solder column attachment.

It could take years for alternative subcontractors to step in to fill the void. Today, only a single subcontractor is designated on the qualified manufacturer list (QML-38535) as a provider of copper wrapped solder column attachment services for the entire FPGA industry. The supply chain is vulnerable should that single supplier suddenly stop providing those services. Past production shortages in the semiconductor industry, in general, have been short-lived because multiple vendors have been able to quickly step in to fill voids in the supply chain. That isn't the case here.

Solder Columns Required

Heritage hardware used in the aerospace and defense industry is built on a platform of FPGA devices with solder columns instead of solder balls. Column grid array (CGA) FPGA packages engaged in mission-critical black box systems are more reliable than ball grid array (BGA) packages. FPGA devices are constructed in some cases with thousands of solder columns, a critical subcomponent smaller than a grain of rice, to electrically connect the FPGA to the printed circuit board

assembly.

These columns are specially made pins and must be attached to the body of the FPGA. Although there are around 10 companies manufacturing radiation hardened FPGAs in the United States, only one small subcontractor is qualified to attach these pins to the FPGA component body.

Is such a monopoly dangerous? What if a catastrophe such as a fire or other unforeseen disaster should disrupt production at the subcontractor? Without solder columns, FPGA cannot be effectively used. No FPGA, no warfighter in the air. It's really that simple.

Column grid array FPGAs are used in mission-critical applications.

Sole Source vs. Single Source

A sole source risk exists when only one supplier can provide a required capability. A single source exists when only one supplier is qualified to provide a required capability. EO 13806 draws a key distinction between sole source and single source. Multiple suppliers may exist, but only a single source for copper wrapped solder columns is currently qualified, according to the Qualified Manufacturing List (QML-38535) published by the Defense Logistics Agency (DLA).

Today, Original Device Makers (ODM) of FPGA devices rely on just one single source subcontractor to attach copper wrapped solder columns for the entire aerospace and defense industry. As of the date of this publication, major ODM device makers, who control over 90% of all FPGA for aerospace and defense, have not taken steps to qualify a second source as a contingency backup. The principal reason cited for such inaction is the lack of a budget to qualify alternative subcontractors.

Manufacturers of defense grade FPGA are well-established companies. Likewise, makers of application specific integrated circuits (ASICs), are also major companies. In fact, approximately 10 domestic companies make defense and space grade FPGA and ASIC devices with solder columns. Monopoly suppliers, though rare in the semiconductor industry, can drive up costs if left unchecked.

Today, 90% of semiconductor companies that make defense grade FPGA are at the mercy of just a tiny, monopoly subcontractor located in Silicon Valley, California. Its owners may be nearing the age when most business owners are contemplating selling the business or retiring. Also, the DLA curtailed on-site field audit visits due to COVID-19 as the primary reason for delays in the certification of FPGA column attach subcontractors. The DLA must be involved to perform qualifications for column attachment; it is a complex process.

Starting from scratch, it might take more than five years for alternative column attachment subcontractors to secure certification from the DLA. In March 2020, after the commencement of the COVID-19 pandemic, travel by DLA employees to conduct facility audits was shelved. Due to a growing backlog of unfulfilled audits for the entire supply chain, it will probably take years for DLA to conduct QML-38535 audits and to certify subcontractors for column attachment.

Consequences

The transfer of ownership of the sole column attachment subcontractor to a hostile foreign player, for example, could suddenly put into motion a series of unintended consequences for the entire defense and aerospace supply chain.

For any number of reasons, an unfriendly acquirer may downscale production, disrupt a level playing field by selectively favoring certain customers, move the facility overseas or choose to completely stop offering column attachment services.

There may be no remedy assuring continuity if such a scenario takes place. Historically monopoly suppliers could actually do the following: increase prices at will; relocate the facility; scale back production levels; shut down operations; and disrupt a level playing field.

This production choke point could disrupt delivery of FPGA devices to thousands of downstream customers involved in supporting National Defense efforts. No "Plan B" exists. A natural disaster or sale of the single source into unfriendly hands could eliminate America's only subcontractor of solder columns serving a multi-billion dollar industry. Measures should be taken now by government and industry to avoid a sudden shortage of mission critical FPGA components to keep warfighters flying.

Affirmative steps to elevate the priority in securing and qualifying a second source capability to attach solder columns should be a top priority, rather than waiting for disaster to strike.

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ELECTRONIC MFG. SERVICES (EMS)

How to End FPGA Single Source Reliance

By Martin Hart, CEO, TopLine Corporation

America's largest electronic chip makers rely on a single source subcontractor to provide solder column attachment services for their chip components. As of the date of this article, no other subcontractor has been certified to perform this service.

As unbelievable as it sounds, should that single source fail for any reason, our Defense and Aerospace industry could easily be compromised, because warfighters and electronic defense systems rely heavily on the production of radiation hardened field programmable gate arrays (radhard FPGAs) and application specific integrated circuits (ASICs).

These electronic components are an integral part of the control and guidance systems of military products ranging from warfighters to missiles and more. Without them, such defense systems cannot operate. These circuit devices incorporate thousands of tiny solder columns that serve to electrically and mechanically interconnect radhard chips to PCBs). These columns must be attached to the device by a qualified subcontractor; no one else is allowed to perform this service.

The U.S. government has yet to shore up weaknesses in the supply chain by not encouraging chip makers to broaden their dependency beyond reliance upon one supplier. This choke point exists because nine out of ten of these chip makers practice a policy of single source procurement that is driven by a relatively small number of civilian decision makers, primarily engineering managers.

CCGA attachment is a mission-critical service.

A Solution Proposed

Although multiple suppliers capable of providing this column attachment service do exist, only a single source is currently qualified for solder columns, according to the Qualified Manufacturing List (QML-38535) published by the Defense Logistics Agency (DLA). Companies that produce radhard FPGAs are not required to voluntarily qualify multiple subcontractors. On top of that, it could take years for an alternative candidate to attain QML status should the current single source supplier of solder columns unexpectedly shut down.

To further compound the problem, there is no plan "B" safety net to protect the defense industry in the event of the loss of this critical

supplier. Nor is there a contingency plan in place should a surge in demand, such as a military mobilization, exceed production capacity.

And, as often has been the case, players in the supply chain are resistant to change. This reluctance has been observed time and time again as the manufacturing and defense industrial base waits until catastrophe occurs before making a concerted effort to correct a supply chain deficiency.

Let's begin with the supposition that any effort to qualify a secondary source of supply for solder column attachment on radhard FPGAs can take three to five years.

The Funding Argument

90% of FPGA device makers seem to be content to accept the status quo by casting their lot with a single source subcontractor. The main reason for inaction, as cited by these electronic chip makers, is the lack of funding needed to qualify another supplier. The cost could be hundreds of thousands of dollars for each FPGA device to qualify alternative subcontractors to provide column attachment services. Conversely, the cost of inaction may exceed hundreds of millions of dollars. Solder column attachment is the Achilles Heel in the assembly process of defense grade FPGA.

The speed with which the current brittle market can be fortified depends on judicious access to funding, which will drive the next steps in the roadmap. Step one is the U.S. Department of Defense incentivizing an industry effort to strengthen the supply chain. Step two requires the engagement of subject matter experts (SME) with intimate knowledge of components used in the defense industry to vet proposals from the supply chain.

If neither step is initiated, then step three should be initiated, i.e., the main producers of FPGA components should allocate adequate resources to aggressively encourage multiple subcontractors to qualify solder column attachment service providers in preparation for certification by DLA.

If none of those steps occurs, then we have step four, in which independent subcontractors in the supply chain deploy their own sources of funding to develop processes to attach solder columns to prepare for DLA certification. Step five follows — a proactive discussion with stakeholders, including the DoD, SMEs, FPGA makers and downstream defense and aerospace customers to gain momentum for developing a resilient, robust supply chain for column attachment services. This course of action is much more desirable than waiting for calamity to strike. The ultimate goal is to provide the defense and space industries with an uninterrupted supply of mission critical FPGA components 10, 20 and even 30 years from now.

Preventable Risk

Risk of an FPGA production shutdown is preventable. The most direct solution is to qualify multiple vendors for critical processes including column attachment services. This remedy requires a relatively low investment by FPGA device makers.

The U.S. DoD provides guidelines to assist the industry to identify and mitigate dependency on services from single-source subcontractors. The Defense Standardization Program Office publishes a helpful document SD-22, titled, "Diminishing Manufacturing Sources and Material Shortages (DMSMS), a Guidebook of Best Practices for Implementing a Robust DMSMS Management Program."

It is a useful resource to aid FPGA device makers seeking to broaden their supplier base for components that are critical to the welfare of national security. The DMSMS guidebook presents the concerns and recommended remedies to mitigate the risk of loss, or impending loss, of manufacturers or suppliers of items, software, and raw materials.

The Under Secretary of Defense for Acquisition and Sustainment delivers an annual report to Congress titled "Industrial Capabilities" stating the mission of the Office of Industrial Policy (INDPOL) is to ensure robust, secure, resilient, and innovative industrial capabilities upon which the DoD can rely. Eight public companies making the majority of the world's FPGA devices may consider issuing forward-looking cautionary statements to shareholders according to guidelines of the Exchange Commission (SEC) citing their reliance on a single QML vendor to attach copper wrapped columns.

These statements disclose potential risks from the perspective of management. Fabrication of copper wrapped solder columns is not trivial, and requires the correct know-how, manufacturing equipment and proficient operator skills to properly attach columns to FPGA packages. Thus, a key focus of the Government ought to be encouraging the supply chain to develop multiple suppliers for attaching columns to FPGA devices.

Advocacy stakeholders should initiate a shared vision to ensure a robust, resilient and sustainable supply chain for FPGA devices. Domestic manufacturing of copper wrapped solder columns is already available. The next step is to qualify multiple microelectronic subcontractors who are ready and willing to provide critical attachment services.

Increased U.S. government support to help fund programs to strengthen this critical area will result in enhanced readiness, greater security of supply, and fewer program delays caused by the potential inability to deliver FPGA components in a timely manner. Where we go from here depends on the successful execution of deliberate steps.

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